

STRUCTURAL DESIGN ANALYSIS MARKET

INPUT

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2180 Sand Hill Road
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(415) 854-3422

15 Bond Street
Great Neck, NY 110
(516) 482-4170

EUROPE

67A High Street
Sutton
Surrey SM1 1DT
England

JAPAN

Overseas Data Service Company, Ltd.
Shugetsu Building, No. 12-7 Kita Aoyama
3-Chome Minato-Ku
Tokyo, 107
Japan
(03) 400-7090

EVALUATION OF THE MARKET FOR
STRUCTURAL DESIGN ANALYSIS

Prepared For:

COMSHARE INC.

JANUARY 1978

INPUT

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STRUCTURAL DESIGN ANALYSIS MARKET

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I INTRODUCTION

I INTRODUCTION

- The objective of this study was to evaluate the market for structural design analysis available to Comshare. Emphasis was placed on:
 - Determining the current and potential markets for Comshare computer products and services within the defined structural/mechanical design analysis population.
 - Determining potential markets for other computer products and services within the defined structural/mechanical design analysis population, and to identify some of these products and their vendors.
 - Determining the most important problems the interviewees want addressed through computer products and services, and to identify the most desired features adaptable to applications packages.
- The following issues were also addressed:
 - Clients' attitudes towards current Comshare products.
 - Unsatisfied needs of clients and prospects in the mechanical, structural, and general design area.
 - Clients' and prospects' plans and attitudes relating to the selection of in-house versus outside services.

- The selection and decision-making procedure for buying outside services:
 - . Budget constraints
 - . Policy constraints
 - . Key buyer(s) and decision makers
- Competing products and services companies.
 - . Strengths and weaknesses
 - . Potential products for Comshare's consideration
- Research for this report was based on telephone interviews conducted in November and December of 1977.
- The interview sample consisted of 41 users or potential users (see Appendix A):
 - The first group of twenty was provided by Comshare and consisted of clients utilizing structural design analysis.
 - The second group was randomly selected from the Fortune 1000 list and concentrated on companies who would utilize the following disciplines:
 - . Mechanical Engineering
 - . Structural Engineering
 - . Aerospace Engineering
 - . Nuclear Power Engineering
 - . Transportation Engineering
 - . Marine Engineering

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

A. MARKET GROWTH FOR STRUCTURAL DESIGN ANALYSIS

- INPUT forecasts the U. S. market for structural design analysis in the discrete manufacturing industry to be the fastest growing segment of the scientific and engineering processing services market.
 - The structural design analysis segment will grow from about \$20 million in 1977 to \$60 million in 1982 (AAGR of 22%) versus a doubling of the total discrete manufacturing portion of scientific and engineering processing services from \$65 to \$130M during the same time period.
- There are about 300 discrete manufacturing companies having \$100 million or more in sales from the Fortune 1000 list that qualify as potential purchasers of structural design analysis computer services. If smaller firms were included, there would be an additional 3,000-5,000 potential firms.

B. COMPETITION

- CDC and McAuto are the major competitors in the structural design analysis processing service industry with cumulative sales of more than 50% of the market.

- CDC's software support and scientific computers are the key to its dominance.
- MCAUTO's strength lies with its staff of experienced engineers and specialized software.
- G.E. is present without a major commitment or a discernible direction.
- CSC is providing a reliable network and good support for the SDRC library of programs.
- UCC is strengthening both its commitment to the marketplace and increasing the level of its support.
- Minicomputer firms have not made an effort to penetrate the structural design analysis market. Tektronics is developing the first intelligent graphic CRT terminal with limited finite element modeling capabilities.

C. ANALYSIS OF THE USERS INTERVIEWED

- Over half of the respondents were companies (or divisions of companies) who had more than five engineers on their staff, and the majority of engineers at these sites used computers for performing design analysis.
- 17 of the 20 responding Comshare users reported using programs from the SDRC library, versus only two from the random sample group where NASTRAN was the most popular product mentioned.
- Most respondents were unaware of any new requirements that would increase their use of outside computer services. In fact, they reported that their management seemed interested in bringing jobs back in-house. Despite this comment, only one of those interviewed believed there would be a decline in

outside computer services expenditures for 1978. Most believed expenses would increase 15 - 25% over 1977.

- The majority of respondents admitted not having a formal budget for EDP structural design analysis.
- Seventy-five percent of all respondents were well satisfied with services provided by outside computer services vendors, particularly the Comshare users.
- Comshare users interviewed reported the following major product strengths and when pressed, supplied some weaknesses:
 - Strengths: "like the language", "reliable", "responsive".
 - Weaknesses: "weak in engineering support", "unable to do a complete job - use U. S. Steel".
- In analyzing the reasons for vendor selection, the user demand for the SDRC library is most important, having 10 of the 35 mentions. The capability of their software received such comments as "unique software capabilities" and "well maintained system." "Price" was not reported as a major factor in vendor selection.

D. REQUIREMENT FOR COMPUTER SERVICES VENDOR CAPABILITIES

- Although respondent companies had annual revenues exceeding \$100 million, and all had in-house systems, there is a feeling among some design engineering groups that their needs are slighted. Several respondents reported that priority was given to general business applications. In order to get their work done, they felt they had to use the services of an outside vendor.

- The smaller the engineering group, the less "clout" it has with the in-house facility and, therefore, the higher the likelihood of going outside.
- Even larger firms with many engineers (i.e., Piper Aircraft) find that McAuto's expertise is so valuable they are willing to forego the possibility of using in-house facilities in order to have access to the software developed by another airframe manufacturer.
- The capability among users to develop their own complex application software is limited. Development is generally restricted to writing small programs peculiar to the needs of a particular group.
- Software and training are the major concerns of the in-house groups and the cost of each is paramount when evaluating the alternatives between the use of in-house or outside EDP services.
- Cost benefits are measured in terms of:
 - Faster turnaround
 - Familiarity with the software
 - Minimum requirement for additional manual calculations

E. RECOMMENDATIONS

I. REQUIREMENTS FOR A HIGHER LEVEL OF CORPORATE IDENTITY

- Achieve a higher level of corporate identity with current users.
 - Many respondents considered Comshare and SDRC to be one and the same.

- A few who knew they had SDRC programs were unaware that they used Comshare.

- This higher level of identity can best be achieved through the utilization of trained personnel who understand the requirements of the users. These support people should have an engineering background and understand how to apply computers to solve a variety of structural design analysis problems.

- The sales and marketing activity should be concentrated on the chief engineer, the Vice President of Engineering or the Manager of Engineering Services.

- All brochures, advertisements, and direct mail promotion should be oriented primarily to emphasize specific cost benefits utilizing case studies. Compare the number of hours spent doing various jobs before utilizing the Comshare service and the improvement in throughput after the use of computer services.

- Contrast with in-house costs whenever appropriate, including all expenses such as:

- . Special support personnel
- . Hardware and software maintenance
- . Education
- . Replacement costs
- . Utilities
- . Supplies
- . Overhead

Most users think in terms of the lease cost or purchase cost and may not be aware of the other "hidden costs" when evaluating in-house systems.

- In the larger firms develop a good relationship with the EDP manager and make him your ally.

- DP managers frequently don't have the right programs, personnel or computers to do complex engineering programs.
- Engineering work is difficult to schedule (unlike payroll, inventory updating, etc.) and conflicts with the organized processing cycle developed by the EDP center.
- DP managers may consider the computer service firm a blessing and a potential rescuer in overflow situations.
- Other less tangible advantages to be cited:
 - Fast turnaround
 - Convenience
 - Responsive support
 - Up-to-date software and methodology

2. A DEDICATED MARKETING APPROACH

• Create a dedicated approach to this market:

- Establish regional specialists to insure that current users are deriving maximum benefit from existing programs.
- Perform telephone prospecting on an on-going basis:
 - Dun & Bradstreet and the Fortune lists are the best sources of names for large and medium-size firms.
 - Special emphasis should be given to the larger multi-division firms. These firms tend to have separate design analysis groups and once a major division has been penetrated, other divisions are often easier to sell.

- Central R & D operations are also potential prospects and are frequently a prestigious group within the company. The capture of this group will provide a foothold which will enable the vendor to expand his account penetration.
- Consider expanding services to include on-site hardware such as an intelligent graphics terminal. The benefits and feasibility of providing minicomputers for pre and post processing should also be explored.
- Continue development of a broad structural design analysis and engineering product line to enable engineers to feel they are getting "everything needed to perform well in their jobs" (e.g., vibration analysis).
- Consider offering current and prospective users additional software for activities such as:
 - Enhanced CAD
 - Automated drafting
 - Graphics and editing packages
- Pricing is still an issue with many companies. Although we don't recommend price reductions, it may be possible to more flexibly tailor prices to fit users requirements. This can be done through selective unbundling, transaction pricing, and volume discounts.
- There may be some benefit in having at least one large scientific (CDC) mainframe dedicated to this market and use the U. S. Steel facility as backup. Right now some customers view Comshare as a middleman rather than a vendor of engineering services.
- Establish a good staff of professional engineers to assist with the marketing effort. This capability provides the professionalism and level of confidence often required to sell a design engineering manager.

- Perform a thorough competitive product line review with particular concentration on CDC and MCAUTO (all five user respondents rating a "high" level of satisfaction -Exhibit III-6).
- Select a prospective client for the joint development of a software product.
- Attempt to secure exclusive licensing agreements for unique application software packages.
- It is INPUT's recommendation that additional research be performed to test the validity of the assumptions developed. The additional research should be focused entirely on two areas:
 - Uncovering prospects
 - Obtaining the expenditure levels of companies.

III RESULTS OF THE SURVEY

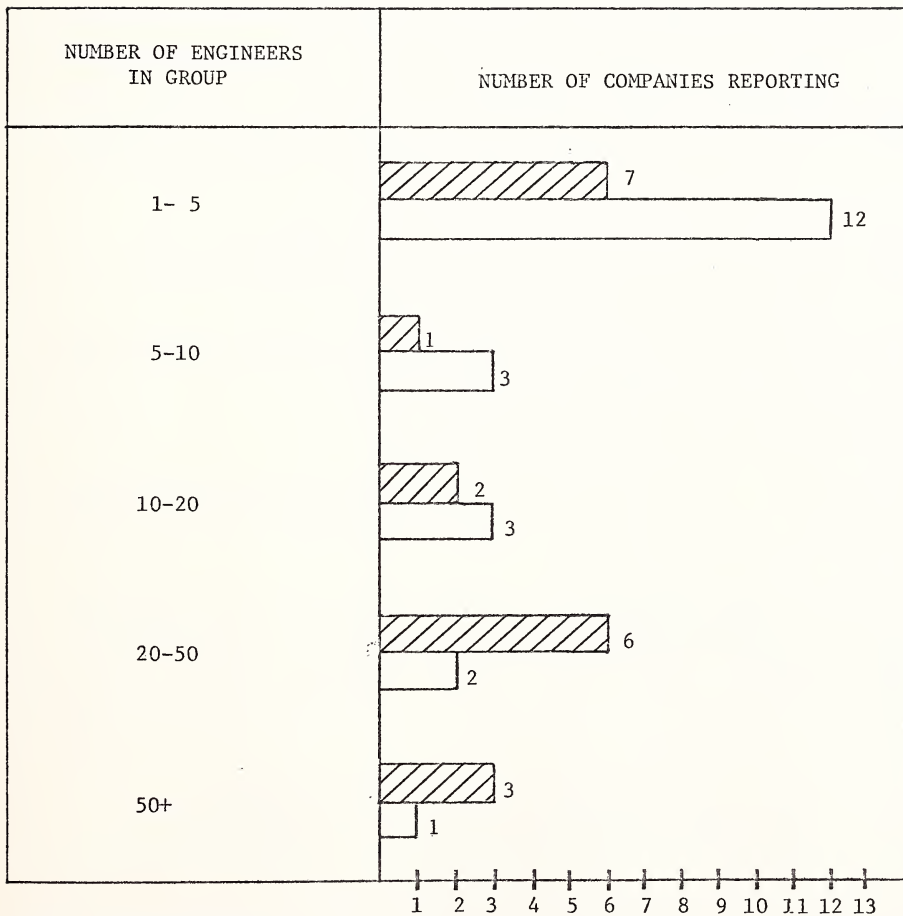
III RESULTS OF THE SURVEY



A. USER IDENTIFICATION

- The first part of the questionnaire was structured to identify users of design analysis functions in order to determine:
 - The number of design analysis engineers at a particular site.
 - Other organizations and physical sites within the company who perform design analysis functions.
- Where significant differences in results occurred between the Comshare and the random samples, each are presented separately.
- Forty-seven percent of respondent users had fewer than 5 engineers on-site while only 13% had 50 engineers or more. (See Exhibit III-1.)
 - The average number of engineers per group from the Comshare sample was 12, while in the random sample the average was 31. The result is biased because the random sample contains a higher proportion of "combined" groups where the design analysis function is not separate from the design function. Specifically, in 57% of the Comshare sample, the analysis function is separate from the design function. While 47% of the random sample reported a separation of the analysis and design functions.

EXHIBIT III-1

NUMBER OF DESIGN ENGINEERS AMONG THE INTERVIEWEES' GROUP



 = RANDOM SAMPLE
 = COMSHARE SAMPLE

- Less than half the interviewees were aware of other groups or divisions within their company performing design analysis functions. The names and locations of other groups mentioned are listed in Appendix B.

B. USE OF COMPUTERS

- The average number of engineers within a group utilizing a computer to perform design analysis exceeded 50%. The random sample group reported 72% of their design analysis engineers used a computer; the Comshare sample reported 54% use. Twelve companies stated that 100% of their engineers used a computer for problem solving.
 - Two of the respondents indicated that the only calculating tools available were desk top calculators.
- Design analysis applications cited by the interviewees are listed in Exhibit III-2.

C. APPLICATION SOFTWARE USED

- The software used by the respondents was clustered around three or four major products, as shown in Exhibit III-3. Among Comshare users, Structural Dynamics Research Corporation (SDRC) was mentioned by 80% of the respondents.
 - Six respondents from the Comshare sample also reported having other in-house software.
- In the random sample, SDRC's software was only mentioned twice. The most frequently mentioned product was NASTRAN (7 of the respondents).

EXHIBIT III-2

APPLICATIONS FOR WHICH DESIGN ANALYSIS IS USED

COMSHARE SAMPLE	RANDOM SAMPLE
VIBRATION CHARACTERISTICS	VIBRATION & IMPACT STUDIES
STRESS MODELING	STRESS ANALYSIS
PRODUCT OPERATING LOAD ANALYSIS	FLUTTER ANALYSIS
SECTION PROPERTY	SPRING DESIGN
BEARING LOADS	SEISMIC SHOCK ANALYSIS
VEHICLE PERFORMANCE	BEARING DESIGN ANALYSIS
PRESSURE VESSEL CALCULATION	STRAIN GAGE & FLOW ANALYSIS
HEAT EXCHANGE CALCULATION	CONTAINMENT STRESS
DYNAMIC RESPONSE ANALYSIS	PIPE FLOW ANALYSIS
FRAME ANALYSIS (LOADED)	FRAME ANALYSIS

EXHIBIT III-3

SOFTWARE USED BY INTERVIEWEES TO PERFORM
DESIGN ANALYSIS FUNCTIONS

COMSHARE SAMPLE		RANDOM SAMPLE	
SOFTWARE	NUMBER MENTIONED	SOFTWARE	NUMBER MENTIONED
SDRC PROGRAMS	17	NASTRAN	7
NASTRAN (IN-HOUSE)	2	STRU DL	4
STARDYNE, BJAC	1 each	STRESS	3
OTHER IN-HOUSE SOFTWARE	6	SDRC PROGRAMS	2
		FEATS, NONSAP, ST3DS, ANSYS	1 each
		TRIFLEX, ICES, SAP, ECAD	1 each
		CIRCUS, STARDYNE, STRUPAC	1 each
		OTHER IN-HOUSE SOFTWARE	7

D. DATA PROCESSING: IN-HOUSE VS. COMPUTER SERVICES VENDORS

- Of the Comshare sample, 13 companies (65%) reported that they used a computer services vendor for 50% or more of their processing, while only 20% of the random sample group (four companies) used 50% or more processing services from a vendor for design analysis (see Exhibit III-4).

E. USE OF COMPUTER SERVICE FIRMS

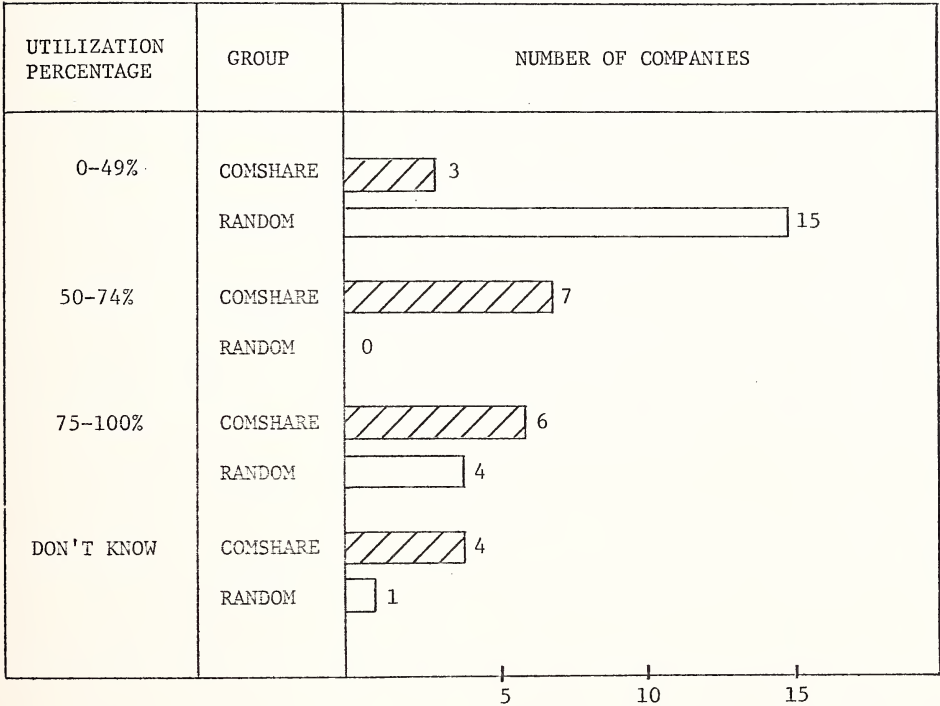
- Exhibit III-5 shows the use of computer service vendors as reported by the users interviewed.
- Although 17 of the Comshare sample reported using Comshare's services, 3 of the 20 interviewed were actually unaware that they were customers of Comshare.
 - Two users thought they were using the GM network and the third believed he was on-line to U.S. Steel's computer.
- Vendors most frequently cited by the random sample were MCAUTO, CSC, and CDC.

F. RESPONDENTS' PRESENT AND PLANNED UTILIZATION OF ADVANCED COMPUTATION TECHNIQUES

- The users of Comshare are more advanced in their use of new computation techniques (particularly finite element modeling) than the randomly selected sample. The percentages of users interviewed who used advanced computation techniques were:

EXHIBIT III-4

UTILIZATION OF OUTSIDE COMPUTER
SERVICES VENDORS FOR DESIGN ANALYSIS



 = COMSHARE SAMPLE

 = RANDOM SAMPLE

EXHIBIT III-5

UTILIZATION OF COMPUTER SERVICE FIRMS

BY THE INTERVIEWEES

FIRMS	COMSHARE SAMPLE	RANDOM SAMPLE
COMSHARE INC.	17	0
CONTROL DATA CORP.	2	3
GENERAL ELECTRIC	2	3
MCDONNELL DOUGLAS		4
COMPUTER SCIENCES CORP.		3
UNIVERSITY COMPUTING CO.		1
U.S. STEEL	2	
GM RESEARCH	2	
CYPHERNETICS	1	1
RAPIDATA INC.	1	
FORD MOTOR		1
EMRC		1
DATA GENERAL		1
RCA		1

	<u>Cornshare Sample</u>	<u>Random Sample</u>
Finite Element Modeling	95%	42%
Graphics	79%	47%
Digitizing	50%	21%

- None of the respondents reported any major design analysis development projects in process.
- Seven of the twenty Cornshare users planned to enhance their current design analysis software either internally or with the help of their vendor.
- Some of the enhancements mentioned by Cornshare respondents were:
 - Automated Drafting Design
 - Computer Aided Design (CAD)
 - Computer Graphics
 - Pre-Processing of Input for Finite Element Model (FEM)
- Enhancements cited by the random sample group were:

- FEM Development	2
- Extension of CAD	2
- Adding Plotter Capability	1
- Graphics Enhancements	1
- Add Thermoplastic Feature To Program	1
- Control and quick response were the two benefits cited most frequently for having an in-house minicomputer or intelligent terminal system. Other reasons reported were:
 - Pre-processing in-house
 - Reduce timesharing expenses

- Failsafe and avoidance of downtime
- Better control of priorities
- Only 17% of all respondents indicated that they were aware of any minicomputer systems used for Finite Element Model analysis.
- In the random sample, two users indicated they had heard of two minicomputer systems for FEM; in the Cornshare sample eight interviewees provided a positive response. Manufacturers of FEM minicomputers cited were Tektronix, DEC, Hewlett-Packard, Applicon, Texas Instruments and General Radio.

G. LIMITATIONS OF IN-HOUSE SYSTEMS

- Limitations to in-house systems are:
 - Limited trained programming personnel.
 - In-house computer inappropriate for structural design analysis applications.
 - Turnaround time unsatisfactory because EDP is controlled by corporate finance. (This often forces engineers to work on odd shifts to use the computer.)
 - The user is not informed about what tools are available. Programs used are out of date and do not have preprocessing capability.

H. INTEREST IN NEW DEVELOPMENTS FOR DESIGN ANALYSIS

- Almost 70% of the respondents said they were unaware of any requirements that would increase their use of computer processing services. Some typical remarks were:
 - "None - computer services are too expensive."
 - "Would only use computer services vendors for spillover or specialized work."
 - "If we need products developed, we'll develop our own."
 - "None - trying to get applications inside."
 - "We are always looking for software to purchase and bring in-house."
- Respondents who could identify products or services which might increase their use of outside services cited enhancements such as:
 - "Improved post processor graphics."
 - "Interference analysis."
 - "Linkage programs."
 - "Electronic tablet."
 - "Simplify data entry."
 - "Electrostatic plotter."
 - "Anything that will improve productivity."

- Working jointly with a vendor to develop software is not a prospect that appeals to the majority of the respondents. Only 6 companies of the Comshare sample were favorably inclined toward joint development versus 8 from the random sample.

I. BUDGETS FOR COMPUTER-AIDED DESIGN ANALYSIS

- Fewer than 50% of the respondents have a formal budget for the structural design analysis function. Of the Comshare sample, 56% don't have a budget nor do 53% of the random sample.
 - Even with an established formal budget, respondents were either unable or unwilling to disclose specific numbers.
 - Fifteen of the respondents in the Comshare sample provided either "didn't know" answers or were unwilling to disclose their budget plans.
 - Eleven of the respondents in the random sample were equally non-committal.
- Although most of the respondents were unwilling or unable to discuss the actual amount of their design analysis DP budget, (see Exhibit III-6 for the budgets of those who did respond) most disclosed both the split between internal and external expenditures as well as their estimate of the growth or decline of their external DP expenditures.
- When the Comshare sample was asked to estimate the change in their external DP budgets for 1978, only one respondent projected a decline. One projected a flat year and those who did respond forecasted increases ranging from 10% to 100%.

EXHIBIT III-6

EXPENDITURES FOR DESIGN ANALYSIS

INTERVIEW NUMBER	TYPE OF MANUFACTURING INDUSTRY	# OF ENGINEERS USING COMPUTER	TOTAL 1977 EXPENDITURES	INTERNAL EXPENDITURES	EXTERNAL EXPENDITURES
COMSHARE					
107	AUTOMOTIVE	12	\$150,000	\$ 45,000	\$105,000
108	CONSTRUCTION EQUIPMENT	16	250,000	125,000	125,000
109	CONSTRUCTION EQUIPMENT	1	24,000	12,500	12,500
112	FOOD EQUIPMENT	1	5,000	1,250	3,750
RANDOM					
123	POWER GENERATION EQUIPMENT	16	\$ 1.6 M	\$ 1.6 M	
127	METALS	20	10,000	10,000	
129	METALS	1	1,000	1,000	
130	CONSTRUCTION EQUIPMENT	65	30,000	24,000	6,000
131	R&D; CONSTRUCTION EQUIPMENT	40	30,000		30,000
135	R&D	25	250,000	250,000	
136	RAILROAD CARS	4	100,000	97,000	3,000

- None of the respondents in the random sample forecasted a decline in external expenditures. Flat expenditures were forecasted by 39% of these respondents. The others forecasted a 10% to 25% increase or didn't know what the expenditures would be.
- The 1982 forecast is more uncertain. Two respondents in the Comshare sample project a decline in their external DP budget, however, six users predicted an increase. Two indicated at least a 50% growth and four were unwilling to commit to a specific number.
- The majority of users are charged for the use of internal computer resources on the basis of corporate overhead or a pre-determined budget.
 - Sixty percent of the Comshare sample and 35% of the random sample are charged in this manner.
 - About 15% of all users are not charged for the use of corporate computer resources.
 - Thirty percent of the Comshare sample are charged for the use of in-house computers based on time and resources used. Only one company from the random sample reported being charged on a usage basis.

J. ENGINEER/MANAGEMENT CONFLICT

- Despite the positive attitude expressed by engineers toward the increased use of computer services, respondents believe that management wants to bring all computing in-house and decrease the use of outside services.
 - The problem for the engineer is that most in-house groups are unable to provide the services needed, and that "management just doesn't seem to understand our needs."

- There is some bias reflected in the respondents' replies, depending upon what level of management they occupy. Typical concerns as perceived by the users are that:
 - The user wants the convenience of the service.
 - The manager wants to economize by bringing services in-house.

K. USER SATISFACTION

- Seventy-five percent of the respondents who evaluated performance of the various computer service vendors were highly satisfied with the service received.
 - Only one user felt that CDC provided him with "no results at a high price."
- Exhibit III-7 shows the respondent's satisfaction with outside services - particularly those provided by Comshare.

L. RESPONDENTS' COMMENTS CONCERNING COMSHARE PRODUCTS

- The majority (75%) of the Comshare users interviewed indicated they are highly satisfied with the Comshare service, and the balance reported being reasonably satisfied. None indicated dissatisfaction. Some of the favorable comments were:
 - "Like the language."
 - "No problems."

EXHIBIT III-7

RESPONDENTS' LEVEL OF SATISFACTION

WITH COMPUTER SERVICES FIRMS

VENDOR NAME	RATING OF VENDORS		
	HIGH	MEDIUM	LOW
COMSHARE	15	4	0
CONTROL DATA CORP	3	1	1
MCDONNELL DOUGLAS AUTOMATION	5	0	0
GENERAL ELECTRIC	2	2	0
COMPUTER SCIENCES CORP	2	0	0
RAPIDATA INC	0	1	0
ADP (CYPHERNETICS)	1	0	0
UNIVERSITY COMPUTING	1	0	0
SERVICE BUREAU	1	0	0
TOTALS	30	8	1

- "Reliable and capable."
 - "Responsive."
 - "Flexible features."
 - "Good editor."
 - "Has all the options."
 - "Easy to use."
- Some of the more negative comments from respondents concerning Comshare were:
 - "They can't do a complete job - they use U.S. Steel."
 - "Program and phone problems."
 - "Weak in engineering support."

M. DECISION MAKERS CRITERIA

- As shown in Exhibit III-8, the most important decision criterion for the selection of a computer service is to compare the ratio of cost and benefit. (This can be subjective unless the vendor proves that the client is saving money by buying the service.)
- The decision to go to an outside service for structural design analysis is generally the responsibility of engineering management.

EXHIBIT III-8

ANALYSIS OF DECISION CRITERIA CITED BY RESPONDENTS

CRITERIA FOR SELECTING SERVICE	NUMBER OF RESPONDENTS REPLYING AFFIRMATIVELY
COST/BENEFIT	12
TIME SAVED/ TURNAROUND	6
EASE OF USE	3
SIZE OF PROJECT	2
SAVE MANPOWER	2
ACCURACY	1
PRESTIGE TO DIVISION	1

- In the smaller organization it is the VP of Engineering or the Chief Engineer, while in the large organizations the "Director of Structural Engineering" or equal is the decision maker.
- The final approval authority for buying computer services among the respondents still rests with the head of engineering in 62% of the interviewed firms.
 - Thirty-one percent of the respondents indicated that a signature had to be obtained from either the President, the Vice President of Finance, Corporate Controller or the Budget Manager before money could be spent with an outside services vendor.
 - In only 7% of the cases was the DP Manager involved in the decision to go outside.
- The following list is representative of the variety of titles involved in the buying decision.
 - Director of Engineering
 - Manager of Engineering
 - V.P. of Engineering
 - Manager, Mechanical Analysis
 - Project Manager
 - Manager, Resources
 - Manager, Engineering Services
 - Manager, New Product Development
 - Director, Structural Engineering
 - Program Director
 - Project Engineer
- When the respondents were asked if they could purchase/lease a minicomputer for pre and post processing, 69% responded "yes." However, when asked if they were considering using a minicomputer for these functions, 73% responded "no."

N. REASONS FOR SELECTING AND USING A COMPUTER SERVICES
VENDOR

- Respondents cited the following reasons as most important in using a computer service vendor (percentage responding positively):
 - Ease of use and lack of problems 33%
 - Responsive service and support 33%
 - Library of programs 24%
 - Flexibility and options 10%
- There seems to be limited communications or transfer of computer service use between departments of an establishment or enterprise.
 - Only 29% of the interviewees were aware that their computer service vendor was also providing services to other departments within the company.
- The vendor selection process, as contrasted from the use, points up the importance of the SDRC library in the selection of Comshare. Exhibit III-9 illustrates the point.

O. COMPUTER SERVICES VENDORS: STRENGTHS AND WEAKNESSES

- Respondents were consistent about what they believed the strengths of the various vendors were: support, service, software and availability were most frequently mentioned.
- Few users reported weaknesses in the service provided by the timesharing vendors:

EXHIBIT III-9

RESPONDENTS' REASONS FOR VENDOR SELECTION

REASONS	NUMBER OF RESPONDENTS REPLYING
WANTED SDRC PROGRAMS AND LOOKED FOR A VENDOR WHO PROVIDED THEM	10
UNIQUE CAPABILITIES OF THE SOFTWARE	8
TECHNICAL SUPPORT PROVIDED BY THE VENDOR	4
CONVENIENCE OF ACCESS AND SERVICE PROVIDED BY THE VENDOR	3
BEST PRICES	2
PLOTTER CAPABILITIES	2
RECOMMENDED BY A CONSULTANT	1
COMMONALITY OF JCL	1
HISTORICAL (VENDOR SELECTED PREVIOUSLY)	4

- Fourteen of the Comshare users saw no weaknesses in the computer services offered.
- Two respondents cited the "high price."
- Others said: "Reps are hard to reach."
 "Not enough lines."
 "Commander system cumbersome."
 "Lack of engineering support."
- Comments on other vendors were mostly favorable with only the following weaknesses cited:
 - "Didn't understand our problem."
 - "Software incompatible with our system."
 - "Not enough pre and post processing capability."
 - "High storage costs."

P. VENDOR REPLACEMENT CONSIDERATIONS

- It takes a 20% price advantage with equal or better service for any of the respondents to consider changing to another vendor. Fifty-six percent of the respondents indicated that a 20% price advantage would cause them to consider another vendor. Other causes for changing vendors are shown in Exhibit III-10.
- Despite the readiness of users to change vendors for a 20% lower price, there is a major concern about training engineers on how to use a new system.

EXHIBIT III-10

REASONS FOR CHANGING VENDORS

REASON	NUMBER OF RESPONDENTS
BETTER COST AND SERVICE	14
POOR SERVICE BY CURRENT VENDOR	3
IN-HOUSE (IF SOFTWARE WERE AVAILABLE)	3
COULDN'T DO IT (EASILY). OUR SOFTWARE IS ON THE VENDORS SYSTEM	3
COMPATIBLE WITH IN-HOUSE SYSTEM	1
IF VENDOR SOLD JOINTLY DEVELOPED PROGRAMS TO OUR COMPETITORS	1

- The retraining time required is crucial; once engineers learn a system they will resist changing unless costs are significantly lower or better applications are provided.

Q. SUGGESTIONS FOR COMPUTER SERVICE VENDORS

- There were three key suggestions made by the respondents to a computer service vendor planning to offer design analysis services:

- Provide information on availability of tools
 - Most engineers don't have (or take) the time to keep current with changing technology. They prefer being kept up to date by the services vendor, especially by "people who can relate to the design engineer."
- Provide seminars on how to use the available tools
 - This should be done with familiar engineering examples; use his terminology and provide opportunities for "hands on" training.
- Provide competent support people
 - Support people should be user oriented and capable of demonstrating and training the use of the system.

- Other requirements mentioned by users were:

- "Low cost, low skill user packages to reduce 3D objects to digital format."
- "Provide simple I/O handlers and graphics."

- "Develop areas of special ty." (e.g., vibration analysis)
- "Be aircraft oriented."
- "Get into FEM and large machines."
- "Better system prompts."
- "Clarity of job control."
- "Graphics facility."

IV REMOTE COMPUTER PROCESSING
SERVICES MARKETS FOR
STRUCTURAL DESIGN ANALYSIS

IV REMOTE COMPUTER PROCESSING SERVICES MARKETS FOR STRUCTURAL DESIGN ANALYSIS

A. MARKET STRUCTURE

- The market for structural design analysis computer services of the Fortune 1000 firms consists of 300 firms (see Exhibit IV-1) engaged in the following industries:
 - Transportation equipment
 - Aircraft
 - Agricultural equipment and machinery
 - Construction equipment and machinery
 - Manufacturing equipment and machinery
 - Mining equipment and machinery
 - Power generating equipment and machinery
 - Machine tool manufacture
 - Marine equipment machinery and vehicles
 - Metalworking
 - Engine manufacture
 - Chemical processing equipment manufacturers
 - Mechanical equipment manufacturers
- If smaller companies were included, the number of potential clients would run into the thousands. Exhibit IV-2 shows the total number of U. S. plants engaged in these industries.

EXHIBIT IV-1

NUMBER OF FORTUNE 1000 FIRMS
WHO ARE POTENTIAL USERS OF DESIGN ANALYSIS

TYPE OF INDUSTRY	NUMBER OF FIRMS TOP 500	NUMBER OF FIRMS SECOND 500
METAL MANUFACTURING	35	31
METAL PRODUCTS	26	45
SHIPBUILDING, RAILROAD & TRANSPORTATION EQUIPMENT	6	11
MOTOR VEHICLES	20	13
AEROSPACE	14	2
INDUSTRIAL AND FARM EQUIPMENT	45	52
TOTAL	146	154

EXHIBIT IV-2

TOTAL NUMBER OF PLANTS

INDUSTRY SIC	NAME OF MANUFACTURING INDUSTRY	TOTAL # OF PLANTS	TOTAL # OF LARGE PLANTS
33	METALWORKING (PRIMARY METALS)	4,213	1,981
355, 356	MANUFACTURING EQUIPMENT	3,855	1,331
354	MACHINE TOOLS	3,177	708
371, 374, 375, 379	TRANSPORTATION EQUIPMENT (EXCEPT AIRCRAFT & SHIPS)	2,218	1,048
353	CONSTRUCTION EQUIPMENT	1,545	624
372, 376	AIRCRAFT/SPACECRAFT	799	430
352	AGRICULTURAL EQUIPMENT	762	259
373	SHIP AND BOAT BUILDING	675	258
351, 361	POWER GENERATION EQUIPMENT	667	358
	TOTAL	17,911	6,997

TOTAL PLANTS = 20 OR MORE EMPLOYEES

LARGE PLANTS = 100 OR MORE EMPLOYEES

REFERENCE: ECONOMIC INFORMATION SYSTEMS

- A realistic estimate of the number of potential enterprises who would use design analysis is 3,000 - 5,000 firms.

B. MARKET GROWTH

- The 1977 market for structural design analysis processing services for the discrete manufacturing industry is estimated to be \$18 - 22 million and growing at 25 - 30% per year over the next five years, reaching \$55 - 65 million by 1981. (See Exhibit IV-3.)
- The companies with the strongest commitment to the market are CDC and MCAUTO. Their market shares reflect this commitment:

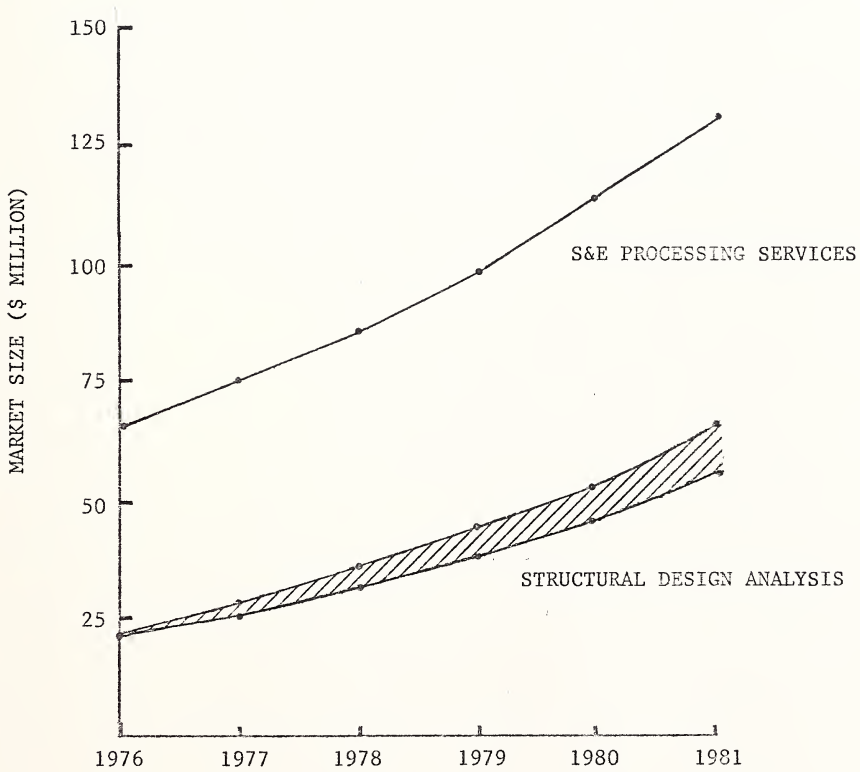
COMPANIES

1977 MARKET SHARE

	<u>Approximate Percentage</u>	<u>Revenue (M)</u>
CDC	30%	\$ 5.5-6.5
MCAUTO	25	4.5-6.0
CSC	15	2.5-4.0
G.E.	12	2.0-3.0
Comshare	5	1.0-1.5
Others	13	2.5-1.0
	<hr/>	<hr/>
Total	100%	\$18.0-22.0

EXHIBIT IV-3

PROCESSING SERVICES MARKET GROWTH
FOR STRUCTURAL DESIGN ANALYSIS
IN THE DISCRETE MANUFACTURING INDUSTRIES



C. COMPUTER SERVICE EXPENDITURES

- Statistics provided by the Bureau of Census indicates there are approximately 200,000 mechanical and aeronautical engineers employed in the discrete manufacturing industry. INPUT estimates 30,000 - 50,000 of these engineers are engaged in design and structural design analysis.
 - If 50% of the engineers involved in design analysis use computers (as reported in the results of this survey) and that each spends \$1,000 a year for computer services, the market forecast of \$18 - 22 million evolves.
- The average annual expenditure for design analysis services among the larger firms (annual sales of \$150 million or more) is approximately \$50,000 and \$10,000 for firms having less than \$150 million in annual sales.

V VENDORS PROVIDING STRUCTURAL
DESIGN ANALYSIS SERVICES

V VENDORS PROVIDING STRUCTURAL DESIGN ANALYSIS SERVICES

A brief description of vendors providing processing services for structural design applications follows:

- BOEING COMPUTER SERVICES is a leader in providing RCS to architects and engineers and R&D organizations:
 - CDC-based "Enhanced KRONOS Service" is used for nuclear and structural problems.
 - IBM-based TSO service supports structural engineering.
 - Offers interactive graphics capability with its engineering services.
 - Structural analysis applications provided: NASTRAN and ICES/STRUDL II.
- COMPUTER SCIENCES CORPORATION does not specialize in any one sector of the engineering industry. However, INFONET does provide computation services on its network for structural design analysis. They offer SDRC's mechanical design library of 20 packages and a proprietary database.
- CONTROL DATA CORPORATION leads other vendors in the level and quality of its support and scientific computers.
 - Structural analysis is CDC Cybernet's main revenue generator.

- CDC recently offered a new product, Unistruc, which is based on Tektronic graphic display terminals.
- Unistruc uses proprietary finite element analysis programs as the front end to standard structural engineering products.
- CDC provides a graphics capability which allows users to graphically enter a model for analysis using pictures of the structure under investigation.
- An automatic subscribing capability for CDC/NASTRAN enhances CDC's conventional structures applications.
- GENERAL ELECTRIC INFORMATION SERVICES' (GEIS) international network makes it a first choice for RCS by multi-national corporations.
 - SDRC's programs are provided on their network. However, they are not technically supported or heavily marketed by GE's staff.
- INFORMATION SYSTEMS DESIGN is a Univac 1108 RCS vendor, although a relatively small one (\$5 million in sales). Market concentration is restricted mainly to California-based companies.
- MCAUTO has one of the largest libraries of engineering programs offered by any vendor.
 - More than 300 people devoted to it, including 190 "consultants" available to clients.
 - IBM and CDC-based remote batch and interactive services.
 - Considered to be the best in the business for graphics support.

- MCAUTO's scientific and engineering revenues broken down by category are as follows:

•	Structural engineering	40%
•	Chemical engineering	15%
•	Civil engineering	10%
•	Electrical power engineering	5%
•	Electronic engineering	5%
•	Project management	20%
•	Other	5%

- NATIONAL CSS offers electrical heating and structural engineering RCS to companies. Only a small portion of their revenues are derived from structural analysis applications.
- OPTIMUM SYSTEMS INC. offers I.C. STRUDL through Project Software and Development Inc. This is a proprietary version of STRUDL.
- STRUCTURAL DYNAMICS RESEARCH CORP. is the leading supplier of software for mechanical engineering.
 - Over \$7 million in sales and nearly 150 people.
 - A growth rate of 30% per year is projected by the company.
 - Revenues from clients range from \$100 to \$100,000 per month.
- UNIVERSITY COMPUTING supports engineers with a variety of generalized finite element analysis programs which include ANSYS, NASTRAN, STRUDL, NISA, SAP IV, SPACE V and MARRS.
 - UCC is attempting to strengthen their position in this marketplace by placing their marketing and technical staff through extensive training programs.

- UNITED COMPUTING SYSTEMS offers a complete range of structural, civil, mechanical, chemical, and electrical engineering packages on multiple CDC systems and has over 30 sales offices.

APPENDIX A: COMPANIES INTERVIEWED

APPENDIX A: COMPANIES INTERVIEWED

A. COMSHARE SAMPLE

- Clark Equipment Company
- DELCO
- Detroit Diesel Allison
- E. I. Dupont de Nemours
- F. Joseph Lamb Company
- Fairbanks Morse Colt Industries
- Fiat-Allis Corporation
- Ford Motor/Tractor Division
- Galion Manufacturing
- General Motors Manufacturing and Development
- Gulf Oil

- Hobart Corporation
- Kelsey-Hayes
- Otis Elevators
- Outboard Marine Corporation
- Owens Corning Fiberglass
- Proctor/Gamble
- Tenneco, Inc.
- Westinghouse Electric
- Winnebago Industries

B. RANDOM SAMPLE

- Allen Test Products
- American Motors
- AVCO Lycoming Division
- Babcock & Wilcox Power Generation Group
- Baker International
- Celanese Chemical

- Crane
- Cremmins Engine
- EASCO, Greinder Engineering Division
- Fansteel, Electro Metals Division
- Hyster
- Walter Kidde, Weber Aircraft
- Morley
- NL Shaffer
- Olin Chemicals Group
- Piper Aircraft
- Rexnord
- Sanders Associates
- Trans Union Corporation
- Trinity Industries, Mosher Steel

APPENDIX B: LOCATIONS OF OTHER
GROUPS/DIVISIONS
WITHIN RESPONDENT
CORPORATIONS WHO
PERFORM DESIGN
ANALYSIS

APPENDIX B: LOCATIONS OF OTHER GROUPS/DIVISIONS WITHIN
RESPONDENT CORPORATIONS WHO PERFORM DESIGN
ANALYSIS

- Fiat-Allis Corporation
 - Deerfield, Illinois
 - Springfield, Illinois
- Ford Motor Light Truck Division
- Outboard Marine
 - Milwaukee Group
- Tenneco, Inc.
 - Bentondorf, Iowa (Bob Barton)
 - Wassau, Wisconsin (Terry Holmes)
 - Terre Haute, Indiana (Art Hirsch)
- American Motors
 - Engineering & Technical Services, Southfield, Michigan and in Wayne, Michigan

- Avco

- Aero Structures Group - (615) 361-2000 and (419) 678-5311

- Babcock & Wilcox

- Component Stress Group, Mt. Vernon, New York
- Support Analysis, Lynchburg, Virginia
- Internal Design, Lynchburg, Virginia
- Small Motors & Pumps, Lynchburg, Virginia

- Fansteel

- VR/Wesson, Waukeegen, Illinois
- Metals Division, Chicago, Illinois
- Advanced Structures, Los Angeles, California

- Rexnord

- Chain & Conveyor Division, (414) 643-2297 (Carl Dimmick)
- Corporate R & D (414) 643-2717 (Fritz Callies)
- Construction Machinery (Bill Mohrbacker)
- Envirex (414) 643-2767 (Dick Race)

APPENDIX C: QUESTIONNAIRE

STRUCTURAL DESIGN ANALYSIS QUESTIONNAIRE

USER IDENTIFICATION

1. Does your group perform the design analysis function for your company?
(division)

Yes ☐No ☐

2. If No - do you know what group performs the design analysis function for
the company?

Please give me the name of the manager and his telephone extension.

Name: _____ Telephone #: _____

(Go to No. 1)

3. How many engineers in your group are involved in the design analysis
function?

- _____
- a) Is the design analysis function separate from the design function?

Yes ☐No ☐

- b) If Yes, who does the design function? _____

4. Are there any other groups in the company (division) performing design
analysis functions?

Yes ☐No ☐

If Yes, continue. If No, go to Question 6.

5. Please tell me where they are and how many engineers involved in design analysis do they have.

<u>Location(s)</u>	<u># Engineers</u>
_____	_____
_____	_____
_____	_____

6. For what product(s) does your group perform design analysis?

<u>Product(s)</u>

USE OF COMPUTERS

7. How many (what % _____) of your engineers use computers to do design analysis?

- 8.a) What types of applications do your engineers use to perform design analysis?;

b) What software do you use for each application?;

c) Are these applications processed on your in-house computer or by a computer service vendor, or combined?;

d) If by a computer service vendor, do you know which one?

<u>Application(s)</u>	<u>Software</u>	<u>In House %</u>	<u>CS Vendor %</u>	<u>Name of CS Vendor</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

INPUT

9. What new design analysis application/software do you plan to implement/use during the next 12 months?

<u>Applications</u>	<u>In-House</u>	<u>CS Vendor</u>	<u>Name</u>	<u>What's Preventing Implementation</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

10. Do you use finite element modeling technique? Yes ☐ No ☐

11. Do you use Pre and Post processing techniques to do:

Graphic Processing Yes ☐ No ☐

Digitizing Yes ☐ No ☐

Other

12. Do you see any benefit other than the obvious cost savings of having an in-house minicomputer or intelligent terminal to be used for design analysis?

12. A. Do you know of any minicomputers used for FINITE ELEMENT METHOD ANALYSIS?

13. What are the limitations of your present in-house design analysis products and services?

14. What products or services, if available today, might increase your use of outside computer services?

- a) Would you be willing to work with a CS vendor to develop such a product/service? Yes ☐ No ☐

BUDGET

15. Do you have an EDP budget for computer aided design analysis? Yes ☐ No ☐

a) What is it for 1977 _____ 1978 _____ 1982 _____

16. What proportion of your design analysis D.P. budget is spent

Internally _____ Externally _____

17. What changes do you see in your external D.P. budget over the next two to four years?

+	1979	+	1982
-	_____	-	_____

18. How are you charged for your internal computer resources?

DECISION PROCESS

19. Who makes decision whether EDP budget should be spent in-house or with a C.S. vendor?

Title _____

20. What criteria are used to make the decision? _____

21. Who has the final approval authority for spending for computer services?

Title _____

22. Could you spend your budget to purchase/lease an intelligent terminal for a minicomputer or a micro on which you could do pre and post processing on design analysis problems? Yes ☐ No ☐

23. Are you now considering such an approach? Yes ☐ No ☐

VENDOR ANALYSIS

24. What outside C.S. vendors do you currently use for design analysis & what is your level of satisfaction and why?

VENDOR NAME	Satisfaction			REASON
	H	M	L	

25. Do you use these vendors for other computer applications and services?
Yes ☐ No ☐

a) If yes which ones?

26. How and why did you select your present C.S. vendor(s)?

27. What do you consider to be the major strengths of your current C.S. vendors' products/services/support as compared to other C.S. vendors?

28. What do you consider to be the major weaknesses of your current C.S. vendors' products/services/support as compared to other C.S. vendors?

29. What would cause you to change C.S. vendors? _____

30. If you were a C.S. vendor what types of products/services and support would you offer in the design analysis and general design area to better serve the user?

INPUT

